Due to its low-cost and ease of production, concrete is the **most-used building material in the world**, providing the foundation for modern cities; from the roofs over our heads, the streets under our feet and the bridges that connect us – as well as the walls that separate us from the natural world.

Most people are so used to being surrounded by concrete that we do not even notice its ubiquity and are unaware of the **ecological damage** that this tool for modernisation has caused.

Climate experts at COP27 called for a reduction of greenhouse gas (GHG) emissions from the construction sector, comprising the concrete, iron and steel industries, which collectively generate 27 percent of the world's industrial carbon emissions. Of these, concrete is responsible for over 7 percent of the world's carbon emissions.

WHAT IS CONCRETE?

Concrete is created by mixing a binding mass, either cement or lime, with fine or coarse aggregates (like stone, gravel or sand) and water.

The cement is a manufactured mixture of materials that includes calcium, silicon, aluminium and iron, among other ingredients. While concrete has been used since ancient civilisations, like the Mayans, the Ancient Egyptians and the Romans, who used different ingredients like limestone and volcanic stone, modern concrete mainly relies on Portland cement.

WHY IS CONCRETE BAD FOR THE ENVIRONMENT?

The creation of cement is the most carbon-intensive portion of the concrete process. This comes down to two main activities: the calcination of limestone and the heating of cement kilns.

To create Portland cement, limestone undergoes a calcination process, which releases large amounts of **CO2** from the chemical reaction. This is the concrete industry's most-pollutive activity, releasing up to 50 percent of the cement industry's carbon emissions.

Additionally, to create cement from raw materials into clinker (an intermediate product), large amounts of energy are required to heat, mix and cool the ingredients in giant kilns.

It is estimated that, in traditional kilns, one tonne of cement produces one tonne of carbon dioxide, although modernised factories have found ways to reduce these emissions.

WATER USE

The creation of cement is also highly-water intensive, especially in the cooling process after materials are baked at extremely high temperatures.

Nature magazine estimated that the concrete industry was responsible for **9 percent of all water** withdrawals from industry. Approximately 16.6 km squared of water are used

annually for concrete production, and this figure is expected to soar as the demand for concrete continues to rise.

By 2025, most of the water withdrawals for concrete production will be in geographical areas that already face water stress.

REDUCES BIODIVERSITY

The rapid urbanisation of the past century has resulted in drastic biodiversity loss, as animals, plants and fungi have found themselves and their ecosystems smothered under **tonnes of concrete**. As much as 80 percent of urban spaces are covered by pavement or buildings, leaving little land for green spaces.

Not many species can adapt to the urban environment, which leaves many without mating grounds, food sources or homes.

The result is a homogenisation of species, which disrupts food chains and ecosystems – including our own food systems. The endangerment of bee species is a key example, as the loss of hive habitats and pollen-producing flowers have caused bee populations to plummet.

AIR POLLUTION

Cement production emits large amounts of toxic substances into the air, which can worsen air quality and lead to respiratory diseases. For example, cement factories have been known to release Sulphur dioxide and **Carbon monoxide**, which can cause or aggravate respiratory issues, like asthma, or cause damage to central nervous systems.

HEAT ISLAND EFFECT

Concrete is notorious for magnifying heat on hot days, creating what is known as the heat island effect. Pavement can increase urban temperatures by up to seven degrees Fahrenheit.

This is especially magnified in lower-income areas of cities, which have less green spaces and plants, and more pavement – leading to sweltering heat and pronounced environmental racism.

CONCRETE SOLUTIONS

Despite the various hazards that concrete and its production generates, humanity is unfortunately far from phasing it out since concrete offers many benefits that are hard to beat. No other material can compete with its value for low-cost of production, durability and strength.

For this reason, concrete was widely adopted to reconstruct war-torn nations after the Second World War, and its ease of creation from widely available **natural resources** has helped spur the urbanisation in the Global South.

Many scientists and engineers, understanding this impact, have worked to come up with

solutions to this issue, the implementation of which could ensure that construction does not lead to destruction.

ENERGY CHANGE

During the cement-making process, materials are heated at very high temperatures, requiring large amounts of energy – mostly powered by fossil fuels. In fact, up to **40 percent** of the industry's carbon emissions come from the heating of cement kilns for this process.

These emissions could be drastically reduced by decarbonising the energy sources for kiln heating, switching instead to renewable energies. Many plants are already switching to green energy, or improving the efficiency of these kilns to optimise energy consumption and reduce costs.

ALTERNATIVE CLINKER

As mentioned, the calcination process to create Portland cement is the most pollutive activity of the concrete industry, generating **50 percent** of its carbon emissions.

Portland cement is widely used due to its low-cost, abundantly available ingredients and reliability. However, replacing **Portland clinker** with an alternative blend of materials – waste materials from production, for example – could reduce emissions by up to 60 percent without compromising the strength of the product.

Governments and environmental institutions could focus on regulating the use of Portland clinker, subsidising alternative blends or taxing the carbon emissions from clinker production to incentivise a change in materials.

CARBON CAPTURE

There is potential to prevent carbon emissions released during the kiln-heating process from entering the atmosphere by using carbon capture sequestration (CCS). However, due to the high expense of CCS, it is not widely adopted and may be difficult to instate in smaller cement plants, especially in the Global South.

Ingeniously, concrete manufacturers have figured out how to inject carbon dioxide captured during CCS into concrete through a process called carbonation curing – therefore locking CO2 into our solid structures and **preventing emissions** from heating the atmosphere.

Source: fair planet